Changing the Thought Pattern and Behaviour of Children with Autism Using Audio-Visual Cognitive Aid

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Abstract

Autism is a severe neurological disorder that is characterized by "severe and pervasive impairment in several areas of development", especially the development in the perception and modulation of sensory information. The prevalence of autism has risen to 1 in 88 births in recent years (Autism Society of America, 2012). Studies show that early intervention and training are the most effective way to help children with autism to cope and eventually become independent. School teachers, parents, or caregivers often face difficulty in communicating with these children because it is hard to understand their thinking and behaviour, especially with those children that have little or no verbal communication. Thus, understanding the thought pattern of an autistic child would be useful for the teachers, parents and caregivers to effectively intervene and redirect the thinking and manage his or her behaviour. The purpose of this study is to use an audio-visual cognitive aid as an intervention tool to understand and help children with autism. An audio-visual cognitive aid was developed and has five themes, (a) colour, (b) light, (c) visual, (d) perception, (e) cartoon, and (f) character. The audio-visual cognitive presentation was shown to 24 children with autism (from very low functioning group to high functioning group) aged between 5-10 years old. Each child attended a 45 minutes session three times weekly over six months. After the children had seen the audio-visual presentation, they were asked to draw and describe what they had seen. Their drawings or descriptions were analyzed for their thinking pattern and conclusions drawn which form the basis for behavioural management. The study showed that the children with autism who participated in this study responded positively to the computer based audio-visual cognitive aid. For very low and low functioning children, this audio-visual cognitive aid has helped to activate their responses to audio and visual stimuli, increase their attention span, responsiveness, concentration, and their cooperative ability. On the other hand, the audio-visual cognitive aid has helped moderate and high functioning children to maintain attention, understand and connect with their environment. This study supports previous studies that computer based programme is an effective tool to understand the thought pattern of autistic children and modify their thinking and behaviour.

Keywords: *Autism, Audio-Visual Aid, Cognitive aid*

Introduction

Autism is a complex developmental disability that typically appears during the first three years of life and is the result of a neurological disorder that affects the normal functioning of the brain. This impacts the development in the perception and modulation of sensory information, especially in the auditory domain which is why autism is often characterized by impairments in

social relationships and interaction, verbal and nonverbal communication, excessive rigidity, repetitive patterns of interests and activities, and lack of pragmatic skills (Kanner, 1943; Rapin & Katzman, 1998; Wing, 2001). Recently, it is reported that the prevalence of autism has risen to an estimated 1 in 88 births (Autism Society of America, 2012). Autism is a spectrum disorder that affects each individual differently and at varying degrees from mild to severe. Research shows that high functioning individuals depict better abilities in associative memory, rule-based tasks, and visual spatial organization but are relatively weak in social cognition and tasks that require cognitive flexibility (Minshew, Goldstein, Muenz, & Payton, 1992). Lower functioning individuals may demonstrate severe receptive and expressive language impairments, and weak in memory recalling (Bristol et al., 1996).

Autism is a life-long disability and its causes are still unknown. Excessive rigidity in both behaviour and thinking is a major characteristic of people with autism (Grandin & Barron, 2005). Children with autism have a preference to take information literally, focusing on details at the expense of the total concept, and weak capacity in understanding meaning and dealing with the multiple perspectives of abstract thinking (Grandin & Barron, 2005; Shah & Frith, 1983). Other than that, the delay in development of language or the absence of language is one of the biggest of concerns and source of stress for the caregivers and parents of children with autism (Bristol, 1984; Howlin & Goode, 1998). Children with autism typically experience difficulties in developing language pragmatics, language functions, and in understanding concepts (Wetherby & Prizant, 2000). Some children with autism would demonstrate repetitive or irrelevant speech. Teachers, parents and caregivers have difficulty communicating with these children because they fail to understand what these children are thinking, especially those with little or no verbal communication.

Computer-Assisted Learning

Computer-assisted learning is a proven tool in the educational process of learning to process vocabulary knowledge, language, speech and communication; and mathematics (Cooke & Dobbing, 2009; Nicolson, 2000; Hall, 2000); and for individuals with special needs (Barker, 2003; Moore & Calvert, 2000). The advantage of using computer based application for learning and training is the ability to present multiple sources of information such as text, pictures, animations, and sounds simultaneously (Dubois & Vial, 2000). Children with autism are more likely to show greater response and improved memory with computer-assisted learning programs due to the multisensory information, controlled and structured environment (Chen & Bernad-Optiz, 1993; Hetzroni & Tannous, 2004). Majority of children with autism are attracted to visual images and are visual thinkers (Grandin, 1995). Interventions have been successful because the techniques or tools used capitalize on the visual strengths (Grandin, 1992; Mesibov, Schopler, & Hearsey, 1994) which is why visual supports are frequently used to help children with autism maintain attention, understand, and organise their environment (Grandin, 1995; Hodgdon, 1995). That are studies that show that children with autism experienced more enthusiasm for computer than toys and displayed increased motivation, attention, learning, response rate, and fewer behavioural problems when computer based learning is used compared with traditional facilitator instructions (Bernad-Optiz, Ross & Tuttas, 1990; Chen & Bernad-Optiz, 1993).

Hodgdon (1995) described that fewer behavioural problems and improved compliance among children with autism when visual supports were used as a tool to communicate expectation. A multimedia program that includes multisensory stimuli such as voice, video and animation was developed by Heinmann, Nelson, Tjus, and Gilberg (1995) to facilitate language learning in

children with autism. The children completed 112 computer-based lessons and demonstrated improvement in reading, phonological awareness and vocabulary. The children also show increased interaction with the instruction during the lessons. Moore and Calvert (2000) tested the effectiveness of a computer software program to teach vocabulary compared to lessons given by a human facilitator. The software program was designed to parallel the behavioural program but was endowed with perceptually salient qualities such as interesting sounds and object movement. Results indicated that children with autism were more attentive, motivated, had better memory, and learned more vocabulary when the computer software was used. Bosseler and Massaro (2003) developed and evaluated a computer-animated tutor, Baldi, to teach vocabulary and grammar to children with autism. Both identification of pictures and production of spoken words were included. The research indicated that the program was effective where the children were found to have learned a significant number of new words and grammar and that learning was stable. Hetzroni and Tannous (2004) investigated the use of a computer software program to build functional language skills in children with autism. An interactive computer program simulating real life situations and conversations was used to teach language form, use and content. Results showed that the children displayed increased functional language use, communicative initiations, motivation to learn, and constant desire to use the program. Through these computer assisted interventions, the children with autism are able to transfer the skills learned to real life social context. They display fewer behavioural problems, increased the use of appropriate functional language, and increased motivation and desire to learn under the facilitated computerized learning environmemnt (Bosseler & Massaro, 2003; Hetzroni & Tannous, 2004; Hodgdon, 1995).

The question arises on the possibility of a computer based auditory and visual aid for understanding the thought patterns of an autistic child so that teachers, parents and caregivers can intervene and redirect thinking in the efforts to manage the child's behaviour and reduce rigid thinking and behaviour. Hence, an audio-visual cognitive aid was designed and used with autistic children in this study, and their responses were observed.

Study Participants

Twenty-four children with autism aged between 5-10 years old were selected from a free service centre for children with autism in Malaysia. This centre provides training programs for 52 children with autism. Only 24 children met the following criteria and were divided into four groups: (1) very low functioning group, with global development of about 1-2 years old; (2) low functioning group, with global development of about 3-4 years old; (3) moderate functioning group, with global development of about 5-6 years old; and (4) high functioning group with global development level equal to the chronological age.

Upon selection, a meeting with all the parents of the selected children was conducted and the parents were briefed on the purpose and requirements of the study, and were given the assurance that the well-being and safety of their child are ensured. All the parents then signed a full parental consent to allow their children to participate in this program and study.

Audio-Visual Cognitive Aid

A computer based audio-visual cognitive aid that is in the form of audio-visual presentation is developed solely for the purpose of this study. The visual images in the presentations were accompanied with music selected to be soothing, and were organised into five collections with the following theme: (a) colour, (b) light, (c) visual perception, (d) cartoon, and (e) character.

(a) Colour

Series of 174 slides of paintings and illustrations were selected where colours clearly formed the defining elements to stimulate the children and gauge their thought patterns with regard to aesthetic values and their ability to see colours as differentiating characteristics in nature. Contrast was introduced with slides that used shades, tone and colours. Slides also progressed from simple line to more complicated forms of abstract art. Many of the slides displayed primary colours blending into other colours in many designs.

(b) Light

There are 44 slides in this collection compiled from paintings of nature and activities. The paintings were mostly selected for their association with weather, the seasons and sceneries. There are obvious related sequences - six initial slides with black and white sketches of activities; 6 others illustrating weather; 17 slides with paintings of sceneries; two slides of lighting at the window; and 11 slides of seasons, day and night. Two other slides of art pieces that are not related to the collection were inserted randomly.

(c) Visual Perception

There are 69 slides in this collection, all of which are visual illusions formed from dots, lines and space elements. Tone and different shades complemented the visual elements. There are slides with dots that eventually coalesce into patterns, objects and abstract art. The abstract art pictures were selected for their colourfulness. There are also slides with line drawing that formed patterns and abstract art; and illustrations that used combinations of lines, dots and space.

(d) Cartoon

The Cartoon collection is made up of two separate sequences. Cartoon I consists of illustrations with colourful background and emphasises expressions such as happiness, sadness, shock, friendship, and love; and activities such as flying, drawing, reading, eating, outdoor, and playing together. Cartoon I is organised to stimulate logical and illogical reasoning in the child. The child was expected to see, imagine and relate the incident behind each slide to his daily routine.

Cartoon II introduces cartoon characters from TV and Film. The cartoon characters were chosen to show varied sizes and to display different facial expressions. They are simple, precise, attractive, and usually colourful. All of the slides have a simple plain background. The child needed to imagine a story from a selection of slides and then describe it (verbally or in drawing).

(e) Character

Portraits by well-known artists, with many selected for distinct facial expressions of feeling, formed this collection. They are of individuals, couples and groups. There are also abstract paintings. The intention is for a child to distinguish between the many faces and be guided to describe or predict the feeling and thoughts behind each facial expression.

Procedure

This study was conducted in a centre for children with autism in Malaysia. A 45 minutes session was provided three times a week per child for six months. For each session, the facilitator selected one or two of the collections and played them to the child while observing the child's behaviour. A video recording was made of the session for later analysis of the child's behaviour and response. At the end of the presentation, the child was asked to draw, write, act out, or talk about what he saw and understood.

Results and Analysis

At bi-monthly intervals ('period'), a qualitative analysis of the children's collected drawing, writing, behaviour, and verbal expression was performed. Conclusions were drawn which will form the basis of suggestions for teachers,

psychologists, social workers, care-givers and parents to use in the training of these children. The analyses focused on the children's behaviour and speech; interpretation, synthesizing and generalization abilities; and creativity.

Since a majority of the children chose drawing as a medium, Furth's (2002) three principles in analyzing drawings were applied. The first principle is to note one's initial impression of a picture which describe his/her initial feeling. The second principle is to systematically comb through the picture objectively for several elements or characteristics such as odd representation, missing elements and focal points such as size, shape distortion, repeated objects, perspective, representation of self into the drawing, shading, edging, comparing to the surrounding world, encapsulation, extension, words in drawing, line drawing, movement, abstract, and space filling. The final principle involves a synthesis of the observations gathered into a report as a whole.

This paper highlights the children's behaviour and speech; interpretation, synthesizing and generalization abilities; and their creativity as seen in the four groups.

(a) Very Low Functioning Group

There were seven children in this group and analysis was conducted for every one of them. For the purpose of this paper, the analysis of the child that showed the most significant change is presented. Child A was a seven years old girl who was only able to make single syllable meaningless sound and indicated her needs by pushing an adult to the particular direction or place. She was non-attentive, liked to throw things on the floor to avoid task, showed no awareness to danger, and constantly displayed temper tantrums by crying or shouting. She sustained odd play, laughing inappropriately, and she needed physical and gesture prompt from the facilitator to get her attention or she would space off. Child A also had self-hurt (knock her head on something or hit her own chest) and self-laugh behaviour. Child A had poor eye contact, tendency to act as deaf, oblivious of her surroundings and averse to cuddling. She was unable to develop peer relationship.

Analysis of Child A's Behaviour, Speech and Drawings:

Table 1: Analysis of Child A's Behaviour and Speech over Three Periods

	1st Period	2nd Period	3rd Period
Behaviour	• Restless and fidgety during the sessions. • Laughed inappropriately, and made meaningless sounds while looking at the audio-visual presentation. • Kept showing hand signs to go to the toilet to avoid the task. • Not responsive to the facilitator's questions. • Poor attention span, easily distracted by others especially when someone was there. • Threw the colour pencils on the floor to escape from drawing.	• Started to be aware of her surrounding, looked and enjoyed the audio-visual presentation. • Laughed inappropriately and make meaningless sounds, not responsive to facilitator's questions and played with the things on the table. Became more focused in the middle of the 2nd period. • Still pushed away facilitator's hand when the facilitator wanted to guide her to draw. • Poor eye contact during the greeting, drawing and colouring part	• Happy and excited while watching the audio-visual presentation. • Allowed the facilitator to hold her hand to draw and to hold her wrist to do the colouring. • Stopped showing hand sign to go to the toilet to avoid the task. • Improved eye contact during the colouring part. This implies that her eye-hand coordination had improved. • Attention span had improved and she was happy and excited

	1st Period	2nd Period	3rd Period
Behaviour	• Pushed away facilitator's hand when the facilitator wanted to guide her to draw. • Poor eye contact during the greeting, drawing and colouring part. • Displayed temper tantrums; banged the table, and hit herself at all the sessions.	• Reduced temper tantrum, but occasionally at the sessions, still banged the table and hit herself for no apparent reason.	to come to the sessions. Started to look at the facilitator during greeting part. • Temper tantrums, table banging, and behaviour of hitting himself were reduced to 3-4 times throughout the period.
Speech	• Non verbal. • Acted as deaf to facilitator's questions most of the time. • Able to do hand sign to go to the toilet. Used it as an excuse to avoid the task. • Made meaningless & angry sounds during the sessions. • Not able to follow instructions most of the time.	• Non verbal. • Acted as deaf to facilitator's questions most of the time. • Still using hand sign to go to the toilet to avoid the task. • Happy and had a smiling face during the drawing part. Make sounds of excitement when she saw the slides that she liked. • Touched facilitator's hands to seek help.	• Non verbal. • Able to understand facilitator's 1-2 instructions. • Responded to the facilitators from time to time with some sounds. • Displayed less meaningless & angry sounds. • Touched facilitator's hands to seek help.

Table 2: Features and Analysis of Child A's Drawings

	1st Period	2nd Period	3rd Period
Description of drawings	• Unable to draw what she saw from the audio-visual presentation. • Repeatedly scribbled vertical line and always scribbled at the same area. • Her drawing strokes were hard on the paper. • There were a lot of empty spaces at the side of the drawing paper. • Not able to choose the appropriate colours. • Liked to use dark colours such as purple, red, and dark blue.	• The drawings still did not display what she saw from the audio-visual presentation. • Not able to choose appropriate colours. • Able to scribble the vertical line and scribbled at the same area. • Coloured out of the line and would scribble all over. • The strokes were softer when she coloured the flowers. • Still liked to use dark colours such as purple, red, and dark blue.	• The drawings still did not display what she saw from the audio-visual presentation. • Started to choose different colours and filled the whole paper with multi-coloured lines, circle and colours. • Repeatedly scribbled the vertical and horizontal line on the drawing paper.
Analysis of drawings	• Drawings were not connected with what she saw. It implied that she had difficulty	• Drawings were not connected with what she saw and it implied that she had difficulty in	• Drawings were not connected with what she saw and it implied that she still had difficulty

	1st Period	2nd Period	3rd Period
Analysis of drawings	understanding and expressing herself. • Was not in touch with what she saw or the surrounding world. • The drawing strokes were hard implying that she had temper tantrum. • Empty spaces at the side of the drawing implied that she lacked psychological energy. • Not able to use multi-colours and appropriate colours showing that she was passive and not participative. • She had surging emotions and was unable to control them.	understanding and expressing herself. • Not able to use multi-colours and appropriate colours showing that she was passive and not participative. • Was not in touch with what she saw or the surrounding world. • The drawing strokes were softer compared to the 1st period implying that there was reduction in temper tantrums. • She still had surging emotions but can be controlled or managed.	understanding and expressing herself. • Showed more energy and participation because she started to use multi-colours and scribbled the whole paper with lines and shapes when prompted. • She started to be aware of her surroundings and accepted the learning of new things.

In summary, Child A was unable to process what she saw in the audio-visual presentation but she started to respond to the presentation by the middle of the 2nd period. Her attention span improved, although she was still easily distracted by others especially when someone comes into the room. She was able to only draw vertical lines. Child A improved during the 2nd period. She became more obedient to the facilitator's instructions. Her obsessive behaviour to draw and colour in her own way reduced since she had started to allow the facilitator to hold her hand or wrist to draw and colour. She would hold the colour pencil or crayon up-side-down throughout the three periods and the facilitator continue to correct her action. The child learnt to manage her behaviours such as banging the table and hitting herself when she was angry; and throwing the colour pencils on the floor. She still coloured out of line but her eye-hand coordination improved overtime. Despite Child A's absence of verbal ability, she was able to understand the facilitator's instruction (in 1-2 words) with physical prompting. The child's behaviour improved from being restless, inattentive, non-cooperative to being more attentive, focused and cooperative. She was able to maintain short eye contact when prompted with gesture and verbal instruction from the facilitator. She still appeared to be oblivious of her surroundings. The audio-visual presentation had helped Child A increase her responsiveness, concentration and cooperation ability.

(b) Low Functioning Group

There were nine children in this group. Child B was an eleven years old girl who had poor eye contact; acted as deaf; had poor turn taking skill; was hyperactive; and constantly displayed crying tantrum. She giggled and laughed inappropriately; showed no awareness to danger; and displayed self-hurting and impulsive behaviours. She would run away from the task assigned to her and behaved aggressively. Besides, she had destructive behaviours such as tearing up the drawing paper and attacking people when she was angry. She was delayed in speech, and said only 1-2 syllable words. She often made meaningless sound to herself.

Analysis of Child B's Behaviour, Speech and Drawings:

Table 3: Analysis of Child B's Behaviour and Speech over Three Periods

	1st Period	2nd Period	3rd Period
Behaviour	• Took a long time (minimum 10 mins) for her to settle down and sit still on the chair to view the audio-visual presentation and to do the drawing. • Laughed inappropriately and mumbled when looking at the audio-visual presentation. Not responsive to the facilitator's questions. • Poor attention span, easily distracted by movements around her. • Threw the colour pencil on the floor to escape from drawing. • Not able to sit still throughout the whole session. Hid under the table and moved away from her seat. • Scratched the facilitator's hand and pull the facilitator's hair when she was angry. • Rocking her body during the sessions. • Demonstrated destructive behaviours during drawing part, such as tearing up the drawing paper and coloured on the wall or table. • Not able to use appropriate colours. • Poor eye contact.	• Was able to settle down and sit still on the chair to view the audio-visual presentation and to do the drawing. • Enjoyed and laughed during the audio-visual presentation. • Responded to some of the questions but with unclear replies. • Attention span had improved. • Reduced in throwing the colour pencils on the floor. • Able to sit still at the beginning of the drawing part, but moved away from her table after 20 minutes. • Reduced behaviours such as scratching the facilitator's hand and pulling the facilitator's hair when she was angry • Pressed hardly on the drawing paper when she was colouring. • Previous destructive behaviour had reduced during the drawing part. • Able to follow the facilitator's advice to use appropriate colours to do the colouring. • Poor eye contact.	• Responded to most of the slides (more than 50%) by pointing to the screen, tried to say the name of the object and laughed. • Able to sit still throughout the drawing session about 30% of the time. However, most of the time, she was able to sit still at the beginning of the drawing part and started to move away from her table after 20 minutes. • Previous bad behaviours had reduced. • Reduced in request to go to the toilet and wet her pants to escape from the task twice. • Previous destructive behaviours had reduced during the drawing part. These behaviours only happened when she was in a bad mood. • Able to follow the facilitator's advice to use appropriate colours to do colouring. • Poor eye contact. • Obsessive with drawing body parts and faces.
Speech	• Able to name some of the pictures (less than 10%) with 1-2 syllable words in the audio-visual presentation such as colours, shapes and some cartoons in Cartoon 1 when asked. • Acted as deaf to the facilitator's questions most of the time.	• Able to name some of the pictures (less than 20%) with 1-2 syllable words in the audio-visual presentation such as colours, shapes, cartoons and light when asked. • Able to point to her body parts when the facilitator named them.	• Able to name some of the pictures (less than 20%) with 1-2 syllable words in the audio-visual presentation such as colours, shapes, cartoons, and light when asked. • More obedient, and able to follow instructions most of the time, especially when she was in a good mood.

	1st Period	2nd Period	3rd Period
Speech	• Able to ask permission to go to the toilet from the facilitator (with sign gestures) but not consistent. • Not able to initiate a conversation. • Made meaningless sounds. • Not able to follow instructions most of the time. • Able to do " hi five" or " high ten" with the facilitator • Touched facilitator's hands to request help.	• Able to wave her hand when she saw the teachers passed by the room.	• Improved in her communication by using hands or signs without verbal cues from the facilitator.

Table 4: Features and Analysis of Child B's Drawings

	1st Period	2nd Period	3rd Period
Description of drawings	• Not able to transfer what she saw into her drawing immediately after she finished watching the audio-visual presentation. • Her drawing strokes were hard when she did colouring. • Preferred using the purple colour. • Colours were out of line and she was not able to use appropriate colours to do colouring. • Scribbled straight lines up and down. • There were a lot of empty spaces at the side of the drawing paper. • She used multi-colours to colour the Mickey Mouse but the colours were all out of line.	• The drawings displayed some related theme that she saw from the audio-visual presentation. • The drawing strokes were softer. • Able to use appropriate colours to colour the body parts. • She coloured Winnie the Pooh's pants with purple. • There were a lot of empty spaces at the side of the paper. • She used multi-colours to colour the drawings but all the colouring were out of line.	• Able to draw what she saw from the audio-visual presentation with gesture and verbal prompts from the facilitator. • Able to choose appropriate colours for colouring. • Used almost all the spaces in the drawing paper to draw and colour. • Reduce in using the purple colour. • Would spell and write some words at the side of a drawing. • Drew picture in complete portion with physical and gesture prompting.
Analysis of drawings	• Not able to process what she saw from the audio-visual presentation. • The drawing strokes in her drawings were hard implying	• Able to refer, encode and transfer what she saw from the audio-visual presentation into her drawing with physical and gesture prompting.	• The drawings had connected with what she saw although she still needed verbal gesture prompt from the facilitator before she started to draw.

	1st Period	2nd Period	3rd Period
Analysis of drawings	that she had impulsive temper. • Inclined to choose purple colour at all time implying that she had a need to have control or support and she was emotional. • Unable to fill up the whole drawing paper implied that she did not have psychological energy for thinking, perceiving, and remembering. • Started to show participation at the end of the session and started to use multi-colours for colouring.	• The drawing strokes were softer, indicating less impulsiveness and tantrums. • Still had a need to have control by using purple colour in all the drawings. • Able to use multi-colours implying more energy and stable emotion. • Started to fill up the whole drawing paper implied that she had psychological energy such as thinking, perceiving, and remembering.	This implied that her ability to understand and express had started to emerge. • Was more aware of what she saw and was able to connect it to her surroundings. • Her emotion became more stable when she started to explore the use of more colours, and had reduced using purple colour. • She started to be aware of what she saw and built her concept on the body structure of people and cartoon.

In summary, Child B started to respond on prompt to the audio-visual presentation by early of the 2nd period as she was able to settle down and sit still on the chair to view the audio-visual cognitive aid and also during the drawing part. Her attention span and her fine motor skill improved during the 2nd period. She followed the facilitator's instructions. Her emotions became more stable as she started to learn to draw. By the end of the 2nd period, she was able to follow the facilitator's encouragement to use appropriate colours to do the colouring and she no longer insisted in using the purple colour. At the 3rd period, she was still obsessive in drawing body parts and faces. Behaviours such as scratching the facilitator's hand and pulling the facilitator's hair when she was in the bad mood had reduced over time. Child B's speech improved and she was able to name some of the pictures (less than 20%) with 1-2 syllable words while she was watching in the audio-visual presentation such as colours, shapes, cartoon, and light when asked. She was able to understand and answered the facilitator's questions in 1-2 words but still would act as deaf to the facilitator's questions sometimes. She was able to maintain short eye contact with the facilitator and with the slides in the audio-visual presentation with gesture and verbal prompts from the facilitator. However, Child B was still not able to initiate a conversation.

(c) Moderate Functioning Group

Among this group of four children, Child C was a seven year old boy who could not wait and displayed temper tantrums by shouting and crying whenever he couldn't do what he wanted. He was obsessed over drawing the same thing (shape of a cartoon character he liked). He had short attention span, laughed inappropriately and he needed gesture and verbal prompt from the facilitator to get his attention or very often stared off into space. He had poor eye contact, liked to play alone, aloof and would act as deaf sometimes. Child C was only able to verbalize certain words and understand 3-4 words instruction with gesture prompt. He had echolalia and unclear speech.

Analysis of Child C's Behaviour, Speech and Drawings:

Table 5: Analysis of Child C's Behaviour and Speech over Three Periods

	1st Period	2nd Period	3rd Period
Behaviour	• Showed no interest to the audio-visual presentation. • Needed to be prompted to look at the slides. • Very quiet and did not respond when the facilitator talked and asked him questions. • Spaced off during the drawing part. Needed a lot of verbal gesture prompts from the facilitator. • Displayed anger and temper tantrum when the facilitator asked him to stop drawing things that were not from the slides.	• Started to focus on the audio-visual presentation. • Watched quietly and able to name few of the slides. • Sang as he drew indicating that he was enjoying the process. • Obsessed with drawing the same thing (shape of a cartoon character he liked). • Followed the facilitator's instructions to stop drawing things that were not from the audio-visual presentation.	• Able to focus on the audio-visual presentation and sit quietly when watching the audio-visual presentation. • Showed interest during the presentation by pointing at the screen and smiling when he saw the slides he liked. • Focused on his work during the drawing parts.
Speech	• Self-talk and made sounds such as "mmm" and "emm" when he was drawing. • Echolalia (repeated the words used by the facilitator). • Able to verbalise few words but unclear.	• Started to respond to the audio-visual presentation by naming the objects in the audio-visual presentation, such as colours and shapes. • Imitated words related to the audio-visual presentation said by the facilitator.	• Able to greet and thank the facilitator. • Able to ask help from the facilitator to sharpen his colour pencils by saying "sharpener". • Able to name the objects he drew. • Able to answer simple questions.

Table 6: Features and Analysis of Child C's Drawings

	1st Period	2nd Period	3rd Period
Description of drawings	• Unable to draw what he saw from the audio-visual presentation. • Repeatedly drew patterns that resemble a cartoon character he likes. • Not able to choose the appropriate colours. • Not able to colour properly and would mess up his drawing by	• Showed improvement where he drew what he saw from the audio-visual presentation with the gestural and verbal prompts from the facilitator or referring to the slide. • Obsessiveness towards drawing the same patterns had reduced. • Able to choose the appropriate	• Able to draw what he saw from the audio-visual presentation with the gesture and verbal prompts from the facilitator or referring to the specific slide. • Able to draw properly and neatly. • Able to choose appropriate colours.

	1st Period	2nd Period	3rd Period
Description of drawings	scribbling all over. His scribbling resembled a cartoon character. • Filled up most of the space on the paper with his drawings.	colour and able to colour properly.	
Analysis of drawings	• The drawings were not connected with what he saw and it implied that he had difficulty understanding and expressing himself. • Was not aware of his surroundings. • Able to fill up the whole paper implied that he had psychological energy to think and remember.	• The drawings were connected with what he saw and this implied that he understood and can express. • Able to refer, encode and transfer what he saw from the audio-visual presentation into his drawing. • Able to colour properly and neatly implying that his fine motor skill (pincher grips) had improved.	• The drawings were connected with what he saw and this implied his ability to understand and express. • More aware of what he saw and was able to connect what he saw to his surroundings. • Able to use multi-colours implied that he was more energetic and participative.

In summary, Child C started to respond to the audio-visual cognitive aid by the 2nd period. He sat quietly to watch the audio-visual presentation. He pointed to the screen, named the picture/object and smiled when he saw pictures/objects he liked. He was more aware of what he saw and connected it to his surroundings during the 2nd period. He was able to draw what he saw from the audio-visual presentation with gesture and verbal prompts from the facilitator or when a specific slide was shown to him. He became more observant and was able to name what he saw in the audio-visual presentation and what he was drawing. His fine motor skill (pincher grips) improved and he was able to colour appropriately and within the lines. His emotions were more stable with his use of more colours in his drawings. His obsession towards drawing the same patterns reduced. His attention span improved where he was able to sit quietly and watched the audio-visual presentation. He was more cooperative and followed the facilitator's instructions. Child C's speech improved and he was able to name the colours and shapes in the presentation, and also the objects he drew. He was able to imitate words used by the facilitator that was related to the audio-visual presentation. He was also able to ask help from the facilitator to sharpen his colour pencils by saying "sharpener". Besides, he was able to maintain short eye contact with the facilitator and the slides in the audio-visual presentation with gesture and verbal prompts from the facilitator. He became more responsive by answering simple questions of the facilitator. He was more interactive as he greeted and thanked the facilitator when he saw the facilitator.

(d) High Functioning Group

Child D from this group of four children was a twelve year old boy with poor attention span. He needed someone to tirelessly attempt to capture his attention and keep him engaged or he would daydream or stare off into space. He had obsession towards specific objects. He spoke in a monotone voice, displayed stereotypical behaviour and had self-talk. Besides, he showed little facial expression. Child D had difficulty in maintaining a conversation with others. He was unable to express his likes and dislikes.

Analysis of Child D's Behaviour, Speech and Drawings:

Table 7: Analysis of Child D's Behaviour and Speech over Three Periods

	1st Period	2nd Period	3rd Period
Behaviour	• Displayed self-laughing, self-talk,and poor attention span while watching the audio-visual presentation. • Facial expression was serious and intense while watching the audio-visual presentation throughout the sessions. • Obsessive with arranging the crayon and colour pencils in certain order and drawing the same objects (such as sheep and clown) which were not related to the audio-visual presentation. • Spaced off & flapped hands during the drawing session.	• Facial expression was less serious and intense. • Smiled at the facilitator when facilitator said something funny or told him a joke. • Able to connect what he saw into his daily life with some gesture and verbal prompts from the facilitator. • Reminded himself to be patient and not to draw or colour half way by saying "Don't do half way". • The obsession of arranging the crayons and colour pencils in certain order was reduced and he complied when the facilitator told him to leave them as they are.	• Able to tolerate whatever arrangement of the crayons/ colour pencils. • Was no longer obsessed in arranging crayons and colour pencils during this period. • Became more patient and was able to finish up drawing. Coloured one thing after another without any prompt from the facilitator.
Speech	• Able to name most of the pictures/objects in the audio-visual presentation. • Able to answer the facilitator's questions in 2-3 words. • Able to communicate with the facilitator. • Able to ask permission from the facilitator when he wanted something.	• Able to answer the facilitator's questions in complete sentences. • Able to explain clearly what he drew and the reasons he chose certain pictures/objects to draw.	• Able to use more words to explain what he drew. • With verbal prompts from facilitator, he was able to talk more on what he drew. • Able to maintain a two-way conversation with the facilitator on what he saw and drew.

Table 8: Features and Analysis of Child D's Drawings

	1st Period	2nd Period	3rd Period
Description of drawings	• Able to draw what he saw from the audio-visual presentation. • Able to use multi-colours in drawing with gesture and verbal prompts from the facilitator. • Able to draw objects in proportion, such as dividing the	• In many of the drawings, he drew people, faces, characters, and animals with emotion such as happiness, angry, sad, and embarrassed. • In one of the drawings, he drew a picture of a family which he	• Able to draw what he saw from the audio-visual presentation immediately after he finished watching the presentation. • Used multi-colours and filled up the whole paper with colourful background.

	1st Period	2nd Period	3rd Period
Description of drawings	land and sky. • Filled up all the space in the paper with multi-colours back-ground.	saw from the presentation, but he put his own family and labeled the characters as his dad, mum and himself. • Able to use multi-colours without any prompt from the facilitator.	• Able to join 2-3 pictures into one drawing. • Able to use appropriate colour tone to make his drawing more colourful and attractive.
Analysis of drawings	• Had psychological energy with thinking and remembering what he saw because he was able to fill the whole paper with drawings and colourful background. • Able to transfer what he saw into his drawing immediately right after he finished watching the presentation. This implied that he had good short-term memory. • Able to talk about what he drew and connected it with his daily life.	• Able to process what he saw into his drawing and transferred what he saw into his drawing and this implied that he was aware of his surroundings. • Started to draw emotions and it indicated that he was aware of the facial expression of people around him. • Able to use multi-colours implying more energy and stable emotion. • Able to use his creativity and imagination to convert the cartoon characters into his family members but with the same theme.	• Able to use correct colour tone to colour his drawing implying his awareness of his surroundings. • Able to draw many pictures that were relevant to what he saw from the audio-visual presentation implying he had creativity and imagination.

In summary, Child D showed improvement in organizing his thoughts into his drawing. By the 2nd period, he was able to process what he saw by drawing what he saw, and connecting it to his life. He became more aware of his surrounding where he drew lots of faces, people, characters, and animals with emotions (such as happy, sad, angry, and embarrassed). He showed an increase in creativity and imagination. He was able to put 2-3 pictures into one drawing and was able to draw more pictures which were related to what he saw from the slides. Child D's obsession with arranging crayons and colour pencils had reduced over the three periods. His facial expression became less serious and intense, and he would smile at the facilitator whenever the facilitator said something funny or told him a joke. He had become more patient and was able to finish up his drawing and colouring systematically (one after another) without any prompt from the facilitator. Child D used more words when he talked to the facilitator. He was also able to respond in full sentence to the facilitator's questions. He was able to explain clearly what he was drawing and the reasons he chose certain pictures to draw. With some verbal prompts from the facilitator, he was able to talk more on what he had drawn. He was also able to maintain a conversation with the facilitator on the theme. Child D was able to maintain eye contact with gesture and verbal prompts from the facilitator. He had become more interactive with the facilitator. With verbal prompt from the facilitator, he was able to talk more about himself, and was able to tell the facilitator what he liked and what he disliked.

Discussion

The purpose of this study is to understand and change the thought patterns of children with autism using an audio-visual cognitive aid that was developed. The children with autism who participated in this study responded positively to the computer based audio-visual cognitive aid. The audio-visual presentation is flexible, easy to develop and can be tailored to the specific needs of the child.

Art has been proven to be an effective method of treatment for children with autism (Bentivegna et al., 1983; Betts, 2001; Evans & Dubowski, 2001; Henley, 2001; Betts & Tabone, 2002; Betts, 2005). Drawing is a good mode for these children especially for those with limited verbal communication to express themselves. Drawing allows them to bring their feelings out visually, which improves their artistic ability as well as their communication skills (Hose, 2010). This study confirms that drawings of children with autism show the mental and physical processes of self-expression, imagination and creativity (Sacks, 1995; Pring et al., 1997; Kellman, 1999; Park, 2001; Hermelin, 2001). It also concluded that colours and space in the drawing of a child are related to his or her emotional and awareness state. In a study that examined the children's emotions with colours, Boyatzis and Varghese (1994) found that light colors such as yellow and blue are often associated with positive emotions (e.g., happy, strong) while dark colors such as black and gray are associated with negative emotions (e.g., sad, angry). A child's drawing which covers the whole paper and uses many colours may be matched to a stable emotion and awareness of his surrounding environment while a child who drew at a certain area and obsessed with a certain colour reflect his or her insecurity. This is inline with the theory of colours as stated by Johann Wolfgang von Goethe (1840).

This audio-visual cognitive aid can be used as a tool to understand and change the thought pattern of the children with autism and train them to be responsive, focused, cooperative, and reduce obsessive and destructive behaviours. The children may acquire the ability to describe and talk about what they see on the computer, and to engage in meaningful conversations through the program. For very low and low functioning children with autism, this program helps to activate their responses to audio and visual stimuli, increase their attention span, responsiveness, concentration, and cooperation ability. Unfortunately, in the absence of the stimulating slides, these children are unable to transfer what they have seen into verbal words, writing or drawing. Their drawings continue to reflect obsessive habits and narrow interests (Selfe, 1977; Sacks, 1995; Park, 2001). The children still need to be trained to match the slides in the presentation with activities from their daily routine. On the other hand, significant improvements are visible for moderate and high functioning children. The audio-visual cognitive aid has helped them to maintain attention, understand and connect with their environment. Their speech ability, eye-hand coordination, and memory have increased while undesirable behaviours have decreased.

In summary, this study supports previous studies that computer based programme is an effective tool to train children with autism and modify their thinking and behaviour to an acceptable norms for their inclusion into the community. All the children with autism in this study reacted positively towards the audio-visual cognitive aid, especially those in the moderate and high functioning groups as their positive change in thinking also affect their behaviour. For future studies, the audio-visual cognitive aid can be modified and adapted to accommodate specific groups and culture. In addition, future studies may include the effect of the audio-visual cognitive aid on normal children.

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English Language

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